

WHAT IS CLAIMED IS:

- 1 1. A tissue stabilizer for endoscopically stabilizing a target tissue
2 within a patient's body, the tissue stabilizer comprising:
3 a shaft sized to allow insertion through an endoscopic cannula; and
4 a manipulable foot connected with the shaft, wherein the foot
5 comprises a first toe portion and a second toe portion, the first and second toe portions
6 being rotatably coupled with the shaft, each toe portion comprising at least one suction
7 port to apply suction to the target tissue during stabilization, the first toe portion and
8 second toe portion rotateable to a first arrangement wherein the foot is insertable through
9 the endoscopic cannula.
- 1 2. A tissue stabilizer as in claim 1, wherein the first and second toe
2 portions are rotatably coupled to the shaft by a split ball joint assembly, the split ball joint
3 assembly allowing the first and second toe portions to rotate with respect to the shaft and
4 with respect to each other.
- 1 3. A tissue stabilizer as in claim 2, wherein each toe portion
2 comprises a ring mount.
- 1 4. A tissue stabilizer as in claim 3, wherein the split ball joint
2 assembly further comprises a top ball shell and a bottom ball shell which together encase
3 the ring mounts of the first and second toe portions to form a spherical split ball shell.
- 1 5. A tissue stabilizer as in claim 4, wherein the toe assembly further
2 comprises a torsion spring to rotate the first toe portion and second toe portion to a second
3 arrangement wherein the first toe portion and second toe portion are at least 8 mm apart.
- 1 6. A tissue stabilizer as in claim 1, wherein the foot further comprises
2 an adjustable ankle coupling the first toe portion and the second toe portion to the shaft..
- 1 7. A tissue stabilizer as in claim 6, wherein the foot is moveable in six
2 degrees of freedom relative to the shaft by adjusting the ankle.
- 1 8. A tissue stabilizer as in claim 6, wherein the ankle comprises an
2 adjustable neck comprising a series of interlocking balls and intermediate socket rings.

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1 9. A tissue stabilizer as in claim 8, wherein each ball is independently
2 rotateable against an adjacent ring to allow the neck to be adjusted.

1 10. A tissue stabilizer as in claim 6, wherein the first toe portion is
2 rotateably joined with the second toe portion by a spherical split ball assembly, and
3 wherein the ankle comprises a housing within which the spherical split ball assembly is
4 disposed.

1 11. A tissue stabilizer as in claim 10, wherein the spherical split ball
2 assembly is rotateable within the housing to adjust the position of the foot in relation to
3 the shaft.

1 12. A tissue stabilizer as in claim 1, further comprising at least one
2 suction tube connectable with the at least one suction port.

1 13. A tissue stabilizer as in claim 12, wherein the shaft comprises a
2 suction lumen and the suction tube is insertable through the suction lumen.

1 14. A tissue stabilizer as in claim 13, wherein the suction tube
2 comprises a suction tip which is connectable with the at least one suction port by insertion
3 into a suction tube receptacle.

1 15. A tissue stabilizer as in claim 1, further comprising an irrigator.

1 16. A tissue stabilizer as in claim 15, wherein the shaft comprises an
2 irrigation lumen and the irrigator is insertable through the irrigation lumen.

1 17. A tissue stabilizer for endoscopically stabilizing a target tissue
2 within a patient's body, the tissue stabilizer comprising:

3 a shaft having a proximal end and a distal end, the shaft sized to allow
4 insertion through an endoscopic cannula;

5 an adjustable ankle connected with the distal end of the shaft;

6 a manipulable foot connected with the ankle, wherein the foot comprises a
7 first toe portion rotateably joined with a second toe portion, each toe portion comprising
8 at least one suction port to apply suction to the target tissue during stabilization, the first

9 toe portion and second toe portion rotateable to a first arrangement wherein the foot is
10 insertable through the endoscopic cannula; and
11 a tension cable passing through the shaft wherein applying tension to the
12 cable locks the ankle in position.

1 18. A tissue stabilizer as in claim 17, wherein the ankle comprises an
2 adjustable neck comprising a series of interlocking balls and intermediate socket rings.

1 19. A tissue stabilizer as in claim 18, wherein each ball is
2 independently rotateable against an adjacent ring to allow the neck to be adjusted.

1 20. A tissue stabilizer as in claim 18, wherein each ball and socket ring
2 has a hollow core through which the tension cable extends.

1 21. A tissue stabilizer as in claim 20, wherein the balls and socket rings
2 are arranged so that applying tension to the cable wedges the balls and socket rings
3 together to lock the ankle in position by friction.

1 22. A tissue stabilizer as in claim 20, wherein the balls and socket rings
2 are shaped so that applying tension to the cable causes at least one ball to apply a force to
3 at least one socket ring at an angle of at least 60 degrees in relation to the cable.

1 23. A tissue stabilizer as in claim 17, wherein the first toe portion is
2 rotateably joined with the second toe portion by a spherical split ball shell, and wherein
3 the ankle comprises a housing within which the spherical split ball shell is disposed.

1 24. A tissue stabilizer as in claim 23, wherein the spherical split ball
2 shell is rotateable within the housing to adjust the position of the foot in relation to the
3 shaft.

1 25. A tissue stabilizer as in claim 23, wherein by applying tension to
2 the cable the spherical split ball shell is locked within the housing so that the position of
3 the foot is fixed in relation to the shaft.

1 26. A tissue stabilizer as in claim 25, wherein the tension cable
2 comprises a locking ball disposed within the housing and wherein applying tension to the
3 cable moves the housing so that the spherical split ball shell is locked within the housing.

1 36. A system as in claim 30, further comprising at least one suction
2 tube connectable with the at least one suction port.

1 37. A system as in claim 36, wherein the shaft comprises a suction
2 lumen and the suction tube is insertable through the suction lumen.

1 38. A system as in claim 36, wherein the suction tube comprises a
2 suction tip which is connectable with the at least one suction port by insertion into a
3 suction tube receptacle.

1 39. A system as in claim 30, further comprising an irrigator.

1 40. A system as in claim 39, wherein the shaft comprises an irrigation
2 lumen and the irrigator is insertable through the irrigation lumen.

1 41. A system as in claim 39, wherein the irrigator comprises an
2 adjustable dispenser terminating in a spout portion.

1 42. A system as in claim 41, wherein the dispenser comprises a
2 plurality of beads coupled in a chain-like fashion.

1 43. A method of endoscopically stabilizing a target tissue within a
2 patient's body, the method comprising:

3 inserting a tissue stabilizer through an endoscopic cannula wherein the
4 tissue stabilizer comprises
5 a shaft having a proximal end and a distal end, and
6 a manipulable foot connected with the shaft wherein the foot
7 comprises at least two toe portions, each toe portion comprising at least one suction port;
8 positioning the manipulable foot against the target tissue; and
9 applying suction to the target tissue through the at least one suction port to
10 stabilize the target tissue.

1 44. The method as in claim 43, wherein the foot comprises a first toe
2 portion rotateably joined with a second toe portion, said method further comprising
3 rotating the first or second toe portions to a first arrangement wherein the foot is
4 insertable through the endoscopic cannula.

1 45. The method as in claim 43, wherein the tissue stabilizer further
2 comprises an adjustable ankle disposed between the foot and the shaft, said method
3 further comprising adjusting the ankle to adjust the position of the foot in relation to the
4 shaft.

1 46. The method as in claim 45, wherein the adjustable ankle comprises
2 an adjustable neck comprising a series of interlocking balls and intermediate socket rings,
3 said method further comprising rotating at least one ball against an adjacent ring

1 47. The method as in claim 45, wherein the first toe portion is
2 rotateably joined with the second toe portion by a spherical split ball shell and wherein
3 the ankle comprises a housing within which the spherical split ball shell is disposed, said
4 method further comprising rotating the spherical split ball shell within the housing to
5 adjust the position of the foot in relation to the shaft.

1 48. The method as in claim 43, wherein the shaft has a suction lumen
2 therethrough, said method further comprising inserting a suction tube through the suction
3 lumen.

1 49. The method as in claim 48, wherein the suction tube has a suction
2 tip, said method further comprising connecting the suction tip with the at least one suction
3 port.

1 50. The method as in claim 43, wherein the shaft has an irrigation
2 lumen therethrough, said method further comprising inserting an irrigator through the
3 irrigation lumen.

1 51. The method as in claim 50, wherein the irrigator comprises an
2 adjustable dispenser terminating in a spout portion, said method further comprising
3 adjusting the dispenser so that the spout portion is directed at the target tissue.

1 52. The method as in claim 51, further comprising supplying a fluid to
2 the irrigator so that the fluid exits the spout portion.

1 53. A method of endoscopically stabilizing a target tissue within a
2 patient's body, the method comprising:

3 inserting a tissue stabilizer through an endoscopic cannula wherein the
4 tissue stabilizer comprises
5 a shaft having a proximal end and a distal end,
6 an adjustable ankle connected with the distal end of the shaft,
7 a manipulable foot connected with the shaft wherein the foot
8 comprises at least two toe portions, each toe portion comprising at least one suction port,
9 and
10 a tension cable passing through the shaft wherein applying tension
11 to the cable locks the ankle in position;
12 positioning the manipulable foot against the target tissue; and
13 applying suction to the target tissue through the at least one suction port to
14 stabilize the target tissue.

1 54. A method as in claim 53, further comprising applying tension to
2 the cable.

1 55. A method as in claim 54, wherein the ankle comprises an
2 adjustable neck comprising a series of interlocking balls and intermediate socket rings,
3 each ball and socket ring having a hollow core through which the tension cable extends,
4 and wherein applying tension to the cable wedges the balls and socket rings together to
5 lock the ankle in position by friction.

1 56. A method as in claim 54, wherein the foot comprises a first toe
2 portion rotateably joined with a second toe portion by a spherical split ball shell and
3 wherein the ankle comprises a housing within which the spherical split ball shell is
4 disposed, and wherein applying tension to the cable locks the spherical split ball shell
5 within the housing so that the position of the foot is fixed in relation to the shaft.

1 57. A method as in claim 56, wherein the tension cable comprises a
2 locking ball disposed within the housing and wherein applying tension to the cable moves
3 the housing so that the spherical split ball shell is locked within the housing.

1 58. A method as in claim 54, wherein the tissue stabilizer further
2 comprises a handle connected with the proximal end of the shaft, and wherein applying
3 tension to the cable includes rotating the handle.

1 59. A method as in claim 58, wherein the handle further comprises
2 ratchet pawls, said method further comprising locking the cable under tension with the
3 use of the ratchet pawls.

1 60. A method as in claim 59, wherein the handle further comprises a
2 release button, said method further comprising depressing the release button to unlock the
3 cable from tension.

1 61. A vessel occlusion device for controlling blood flow in a blood
2 vessel, the device comprising:
3 a plate-like body having a bore intersecting a radial slot;
4 a flexible member having a free end and fixed end, wherein the fixed end
5 is fixedly attached to the body and wherein the flexible member has a diameter sized so
6 that the member is frictionally held in the radial slot upon insertion of the free end into
7 the radial slot.

1 62. A device as in claim 61, wherein the flexible member comprises
2 silicone tubing.

1 63. A device as in claim 61, wherein the plate-like body has a length of
2 approximately 7.9 mm and a width of approximately 2.5 mm.

1 64. A device as in claim 63, wherein the plate-like body has a depth of
2 approximately 1.3 mm.

1 65. A device as in claim 63, wherein the bore has a diameter of
2 approximately 1.3 mm and a slot width of approximately 0.25 mm.

1 66. A device as in claim 65, wherein the flexible member has an outer
2 diameter of approximately 0.05 inches.

1 67. A method of endoscopically preparing a blood vessel associated
2 with a target tissue for a surgical procedure, said method comprising:
3 endoscopically positioning a tissue stabilizer at a first location against the
4 target tissue to stabilize the tissue;

5 endoscopically positioning at least one vessel occlusion device around the
6 blood vessel to restrict blood flow therethrough;
7 removing the tissue stabilizer from the target tissue while the vessel
8 occlusion device remains in place.

1 68. A method as in claim 67, further comprising repositioning the
2 tissue stabilizer to a second location against the target tissue while the vessel occlusion
3 device remains in place.

1 69. A method as in claim 67, wherein the tissue stabilizer comprises a
2 shaft sized to allow insertion through an endoscopic cannula and a manipulable foot
3 connected with the shaft, wherein the foot comprises a first toe portion rotateably joined
4 with a second toe portion, the first toe portion and second toe portion rotateable to a first
5 arrangement wherein the foot is insertable through the endoscopic cannula, and wherein
6 endoscopically positioning the tissue stabilizer comprises positioning the foot against the
7 target tissue.

1 70. A method as in claim 67, wherein the vessel occlusion device
2 comprises a plate-like body having a bore intersecting a radial slot and a flexible member
3 having a free end and fixed end, wherein the fixed end is fixedly attached to the body, and
4 wherein endoscopically positioning at least one vessel occlusion device comprises
5 passing the free end of the flexible member around the blood vessel and into the radial
6 slot so that the member is frictionally held.

1 71. A method of controlling blood flow in a blood vessel, said method
2 comprising:
3 providing a vessel occlusion device comprising
4 a plate-like body having a bore intersecting a radial slot, and
5 a flexible member having a free end and fixed end, wherein the
6 fixed end is fixedly attached to the body;
7 passing the free end of the flexible member around the blood vessel and
8 through the bore so that the blood vessel is encircled by the flexible member and the
9 plate-like body;
10 pulling the flexible member so that the blood flow is restricted in the blood
11 vessel; and

12 sliding the flexible member into the radial slot so that the member is
13 frictionally held.

1 72. A method as in claim 71, further comprising sliding the flexible
2 member out of the radial slot to release the flexible member so that blood flow through
3 the blood vessel is increased.

1 73. A method as in claim 71, further comprising adjusting the position
2 of the flexible member by sliding the flexible member out of the radial slot and re-sliding
3 the flexible member into the radial slot.

1 74. A method as in claim 71, further comprising:
2 providing a tissue stabilizer for endoscopically stabilizing a target tissue
3 within or upon which the blood vessel is disposed; and
4 positioning the tissue stabilizer against the target tissue to stabilize the
5 tissue.

1 75. A tissue stabilizer for endoscopically stabilizing a target tissue
2 within a patient's body, the tissue stabilizer comprising:
3 a shaft sized to allow insertion through an endoscopic cannula; and
4 a manipulable foot connected with the shaft, wherein the foot comprises a
5 first toe portion and a second toe portion,
6 the first and second toe portions being rotatably coupled with the shaft by
7 a rotating joint assembly, the rotating joint assembly providing that at least one of the first
8 and second toe portions are rotatable with respect to the shaft and providing that the first
9 and second toe portions are rotatable with respect to each other,
10 the first toe portion and second toe portion rotatable to at least a first toe
11 arrangement wherein the foot is insertable through the endoscopic cannula.

1 76. A tissue stabilizer as in claim 75, wherein each toe portion
2 comprises at least one suction port configured so as to apply suction to the target tissue
3 during stabilization.

1 77. A tissue stabilizer as in claim 75, wherein the first toe arrangement
2 is configured so that the first toe portion lies overlapping at least a portion of the second
3 toe portion.

1 78. A tissue stabilizer as in claim 77, wherein the rotating joint
2 assembly comprises a first a pivotal joint and a second pivotal joint, the first and second
3 pivotal joints being coupled to the first and second toe portions respectively.

1 79. A tissue stabilizer as in claim 77, wherein the rotating joint
2 assembly comprises a split ball joint assembly.

1 80. A tissue stabilizer as in claim 79, wherein the split ball joint
2 assembly further comprises a first split ball portion coupled to the first toe portion, and a
3 second split ball portion coupled to the first toe portion, the first and second split ball
4 portions being disposed adjacent one another so as to define at least a portion of a
5 generally spherical ball assembly.

1 81. A tissue stabilizer as in claim 80, wherein each toe portion
2 comprises a ring mount.

1 82. A tissue stabilizer as in claim 81, wherein the first split ball portion
2 is disposed adjacent the ring mount of the first toe, and the second split ball portion is
3 disposed adjacent the ring mount of the second toe, the first and second split ball portions
4 together encase the ring mounts of the first and second toe portions.

1 83. A tissue stabilizer as in claim 75, further comprising an adjustable
2 ankle disposed between the foot and the shaft and coupling the foot to the shaft.

1 84. A tissue stabilizer as in claim 75, further comprising an irrigator.

1 85. A tissue stabilizer as in claim 75, further comprising at least one
2 suction tube connectable with the at least one suction port.

1 86. A tissue stabilizer as in claim 75, further comprising a tension
2 cable passing through the shaft wherein applying tension to the cable locks the foot in
3 position with respect to the shaft and locks the toe portions in position with respect to one
4 another.

1 87. A tissue stabilizer as in claim 75, further comprising at least one
2 cleat device mounted to a portion of the foot, the cleat device being configured to
3 releasable hold a flexible elongate member for vessel occlusion.

1 88. A joint assembly for adjustably supporting a portion of an
2 endoscopic surgical instrument, comprising:
3 at least one ball member having a generally axially symmetrical convex
4 external surface portion;
5 at least one socket member having a generally axially symmetrical
6 concave internal surface portion; and
7 the ball member mating with the socket member by contact of the convex
8 surface portion with the concave surface portion.

1 89. The joint assembly of claim 88, wherein the convex surface portion
2 of the ball member has a curvature in the axial direction which is substantially greater
3 than the curvature in the axial direction of the concave surface portion of the socket
4 member, the contact between the convex portion and the concave portion defining a zone
5 of contact spaced radially outward from the axis of the socket portion.

1 90. The joint assembly of claim 89, wherein the convex surface portion
2 of the ball member has a generally spherical contour, and the concave surface portion of
3 the socket member having a generally conical contour.

1 91. The joint assembly of claim 90, wherein each of the ball member
2 and the socket member have a core lumen, the core lumen of the ball member being in
3 communication with the core lumen of the socket member, the zone of contact being
4 spaced substantially radially outward from the core lumen of the ball member.

1 92. The joint assembly of claim 91, further comprising a compression
2 mechanism configured to selectably urge the ball member against the socket member, so
3 as to produce a selectable frictional engagement of the ball member with the socket
4 member to provide resistance to rotation of the ball member with respect to the socket
5 member.

1 93. The joint assembly of claim 92, wherein the compression
2 mechanism includes a flexible tension member passing through each of the core lumens,
3 the tension element coupling at a first end to the ball member and at a second end to the
4 socket member, the compression mechanism providing for selectably retracting the
5 tension member so as to urge the ball member against the socket member.

1 100. A method of endoscopically stabilizing a target tissue within a
2 patient's body, the method comprising:
3 inserting a tissue stabilizer through an endoscopic cannula wherein the
4 tissue stabilizer comprises
5 a shaft having a proximal end and a distal end, and
6 a manipulable foot connected with the shaft wherein the foot
7 comprises at least two toe portions; and
8 positioning the tissue stabilizer with the use of a robotically operated
9 surgical instrument from within the patient's body.

1 101. A method as in claim 100, wherein positioning the tissue stabilizer
2 comprises positioning the manipulable foot against the target tissue.

1 102. A method as in claim 101, wherein positioning the manipulable
2 foot comprises grasping at least one of the toe portions with the robotically operated
3 surgical instrument.

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